

The invention claimed is:

1. An apparatus comprising:

a substrate having at least one aperture having a tapered portion with a top diameter greater than a bottom diameter and wherein the tapered portion of the aperture transitions into a cylindrical portion having a diameter equal to said bottom diameter of said tapered portion;

cross-linkers attached to the inner walls of said aperture; and

a macro-cyclic ring, having a diameter substantially the same as the diameter of the cylindrical portion of said aperture, attached at or near the circumference of one end of the cylindrical portion of said aperture.

2. The apparatus of claim 1, wherein the substrate is chosen from the group consisting of glass, carbon, polymeric materials, and semiconductors.

3. The apparatus of claim 1, wherein the macro-cyclic ring has a rigid phenylethynyl backbone.

4. The apparatus of claim 1, wherein a biological or chemical probe is attached to the macro-cyclic ring such that the biological or chemical probe extends into and rests between at least a portion of the surfaces of the inner walls of the cylindrical portion of said aperture.

5. The apparatus of claim 4, wherein the biological probe comprises a single strand sequence of DNA.
6. The apparatus of claim 1, wherein the substrate comprises a layer of Silicon Nitride, a Silicon On Insulator (SOI) wafer and a layer of Silicon Nitride
7. An apparatus comprising:
  - a substrate having at least one aperture having a tapered portion with a top diameter greater than a bottom diameter and wherein the tapered portion of the aperture transitions into a cylindrical portion having a diameter equal to said bottom diameter of said tapered portion;
  - cross-linkers attached to the inner walls of said aperture; and
  - antibodies or chemical functional groups deposited around the inner walls of the aperture or around the circumference of one end of said aperture.
8. The apparatus of claim 7, wherein the substrate is chosen from the group consisting of glass, carbon, polymeric materials, and semiconductors.
9. The apparatus of claim 7, wherein the substrate comprises a layer of Silicon Nitride, a Silicon On Insulator (SOI) wafer and a layer of Silicon Nitride.

10. A method comprising:

providing a substrate having at least one aperture having a tapered portion with a top diameter greater than the bottom diameter and wherein the tapered portion of the aperture transitions into a cylindrical portion having a diameter equal to said bottom diameter of said tapered portion; and

functionalizing said aperture to bind to a specific biological or chemical moiety.

11. A method comprising:

providing a substrate having at least one aperture having a tapered portion with a top diameter greater than the bottom diameter and wherein the tapered portion of the aperture transitions into a cylindrical portion having a diameter equal to said bottom diameter of said tapered portion, wherein said aperture is functionalized to bind to a specific biological or chemical moiety; and

passing a sample through said aperture while simultaneously measuring the variation in ionic current across the depth of said aperture.